



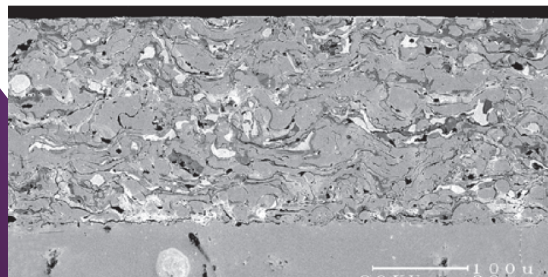
OIL-FREE TURBOMACHINERY—FOIL GAS BEARINGS

TECHNOLOGY OPPORTUNITY

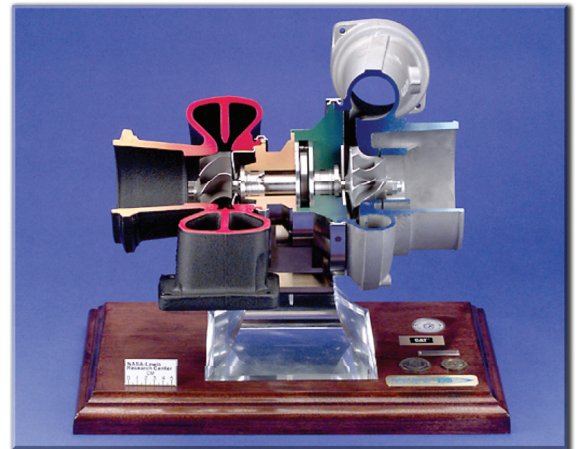
NASA Glenn's Oil-Free Turbomachinery research team has developed foil gas bearing technology and know-how that enables the commercialization of a broad array of revolutionary Oil-Free gas turbines, compressors, blowers, motors, and other rotating machines that can operate from cryogenic to red-hot temperatures.

BENEFITS

- Foil gas bearings use no oil and operate without maintenance leading to simple designs and often substantial weight savings.
- Foil gas bearings rely on a hydrodynamic (self-generated) gas film for lubrication and do not need external pressurization. Any ambient gas serves as the lubricant.
- Foil gas bearings have no rolling elements and thus eliminate ball bearing imposed shaft speed (DN) limits allowing machinery to run faster and longer.
- NASA patented PS300 and PS400 coatings enable operation to 650 °C and beyond, conventional polytetrafluoroethylene (PTFE)-based coatings provide low cost path for bearings for use to 300 °C.
- A substantial technology push over the last two decades has greatly “demystified” this valuable technology and provides simple path to commercialization. Public domain know-how covers bearing design, manufacturing, coatings, testing, and applications.



Cross section of PS304 coating.



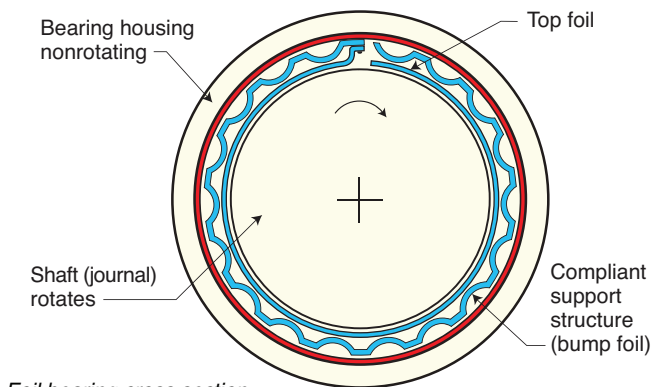
Cutaway view of world's first Oil-Free turbocharger.

COMMERCIAL APPLICATIONS

- Oil-Free foil bearings have been commercialized in aircraft air cycle machines (ACMs) for cabin pressurization and cooling, in cryogenic turbo-compressors, and microturbine electrical generators (15 to 250 kWe).
- Emerging applications include Oil-Free turbochargers for cars and trucks, larger turbine generators, General Aviation (GA), BizJet, unmanned aerial vehicles (UAVs), and missile engines.
- Future applications are anticipated in auxiliary power units (APUs), regional jet and helicopter engines, revolutionary aeropropulsion engines, space power systems and launch vehicle cryogenic turbomachinery.
- Near-term markets include Oil-Free wastewater aeration blowers, industrial blowers and point-of-use air compressors, electrically driven automotive superchargers, fuel cell blowers, and hybrid power train microturbines.

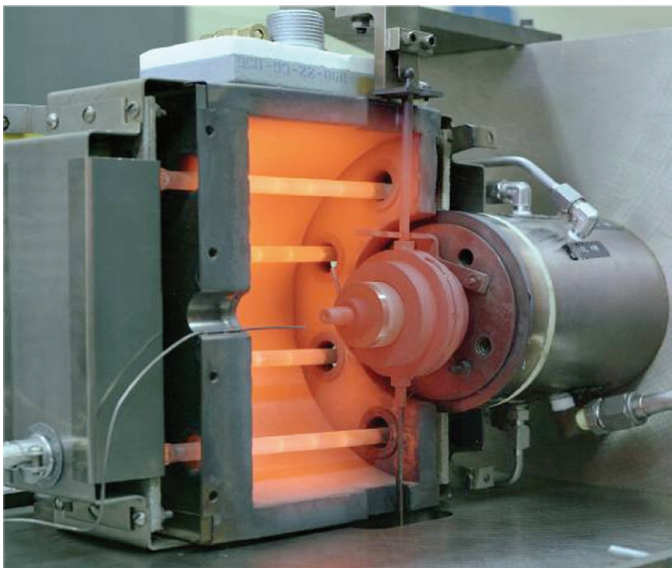
TECHNOLOGY DESCRIPTION

Oil-Free foil gas bearings are self-acting hydrodynamic bearings that are ideal for high-speed, lightly loaded shaft support. During initial startup, the bearing surfaces, made up of thin sheet metal foils, rub lightly and solid lubricants must be used to reduce friction and wear. At high speeds, a gas film forms that separates the shaft from the foils providing a low friction, wear-free bearing. This design requires no external pressurization. Since air cannot burn like oil, foil bearings can operate at high speeds (no bearing DN limit) over a wide temperature range and tolerate misalignment and distortion.



Foil bearing cross section.

Foil bearings have long been used in aircraft cabin cooling and pressurization compressors where their intrinsic "Oil-Free" characteristic has been paramount. Research at NASA Glenn and elsewhere over the last two decades has greatly enhanced foil bearing capability and application know-how resulting in many new uses and applications. Our technical staff has continuously published our findings in the open literature greatly aiding the industrial development of Oil-Free microturbine generators, turbochargers and other high speed rotating machines operating on foil gas bearings.



Red-hot foil bearing.

OPTIONS FOR COMMERCIALIZATION

NASA has strived to disseminate sufficient information to enable multiple entities membership in the Oil-Free community. Numerous industry sources for foil air bearings now exist that are eager and capable of assisting OEMs and suppliers to apply this technology to rotating systems. Many bearings designs, some still under patent protection and others no longer restricted, are available for development and use. Recently developed design guidelines, manufacturing details and processes, and modeling tools are now readily available. The NASA Glenn research team can provide guidance and is seeking opportunities for partnerships.



Typical turbocharger applications.

LICENSING AND PARTNERING OPPORTUNITIES

Glenn's Office of Technology Partnerships and Planning seeks to transfer technology to and from NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Oil-Free Turbomachinery Foil Gas Bearings.

FOR MORE INFORMATION

For more information about this and other technology licensing opportunities, please contact

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